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Raising Household Energy Prices in Poland

Who Gains? Who Loses?

Caroline L. Freund
Christine I. Wallich

Programs that subsidize household energy prices in the transition economies help the rich more than they help the poor. Not only do the wealthy consume more energy in absolute terms than the poor, but they also spend a larger portion of their income on energy.

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Summary findings

Freund and Wallich examine the welfare effects of increasing household energy prices in Poland. Their main finding is that the policy of subsidizing household energy prices, common in the transition economies of Eastern Europe and the former Soviet Union, is *regressive*.

Such programs do help the poor by providing them with lower-cost energy, but they are more useful to the rich, who consume more energy.

What is surprising is the extent to which Poland's nonpoor have benefited from lower energy prices. Not only do the wealthy consume more energy in absolute terms than the poor, but they also spend a larger portion of their income on energy.

Their analysis allowed Freund and Wallich to rule out the oft-used social welfare argument for delaying increases in household energy prices, but they do not try to recommend a dynamically efficient pricing path.

The first-best response would be to raise energy prices while targeting cash relief to the poor through a social assistance program. This is far more efficient than the present go-slow price adjustment policies, which imply energy subsidies that provide across-the-board relief to all consumers.

But if governments want to provide *some* relief for consumers to ease the adjustment, several options are available: in-kind transfers to the poor, vouchers, cash transfers, and lifeline pricing for a small block of electricity combined with significant price increases.

Simulations show that if raising prices to efficient levels for all consumers is not now politically feasible, it may be *socially better to use lifeline pricing and a large price increase rather than an overall (but smaller) price increase*. Lifeline pricing for electricity in combination with an 80-percent price increase has better distributional effects than a 50-percent across-the-board price increase.

Ideally, the public utility would be compensated from the budget for any reduced-price sales, rather than having to finance them through internal cross-subsidies. In-kind transfers to poor households are also effective in terms of efficiency, but may be harder to administer in some countries than lifeline pricing.

This paper — a product of Europe and Central Asia, Country Department II, Office of the Director — is part of a larger effort in the region to better understand the impact of cost recovery on the poor. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Gemma Langton, room H11-075, telephone 202-473-8392, fax 202-477-1034, Internet address glangton@worldbank.org. August 1995. (50 pages)

Raising Household Energy Prices in Poland: Who Gains? Who Loses?

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Introduction

A legacy of the social contract under central planning, many forms of energy in the transition economies today are still supplied to households at well below their costs. Raising prices to economically efficient prices is therefore a priority. More appropriate prices are needed to create more efficient consumption patterns and to improve the financial viability of energy-sector companies. But, raising household energy prices has not been easy in most countries that have tried it, and will not be easy in Poland, either. This paper seeks to determine the gainers and losers from such a price adjustment by estimating the welfare cost to households in different income groups of increasing household energy prices to efficient levels.

Several characteristics distinguish energy consumption in Poland and other transition socialist economies from energy consumption in market economies, which have a bearing on how raising prices will affect welfare. First, the residential sector consumes a large share -- 30 percent -- of total final energy. This is in part due to households' heavy dependence on energy for heating, lighting, as well as other consumption activities, especially as compared to the developing countries. Second, the extent of price controls and production subsidies that prevailed under the former regime, many of which continue to distort the economy, makes for a qualitative difference as compared to the underpricing of energy that can also be found in industrial and developing market economies. Third, middle and high income consumers spend a larger share of their budget on energy than low income consumers.

The first feature tells us that energy consumption in the residential sector is a significant portion of total energy consumption; thus price changes in this sector should have real effects on production as well as consumption. The second feature implies that the price changes that may be ultimately needed will not be marginal. The third point implies that high income families are benefitting the most from price controls. Increasing energy prices in the residential sector would, therefore, reduce the "leakages" implied by this form of "social assistance" while also providing a greater incentive to conserve energy.

The purpose of this paper is to provide some empirical evidence relating to the interaction between pricing policy in the energy sector and social welfare. Section 1 describes the "stylized facts" with respect to past approaches to pricing household energy in the transition economies; some of the changes that have been introduced since the inception of the transition in 1989; and the attempts that have been made in Poland and other transition economies to raise prices. Section 2 focusses on the characteristics of energy consumption in Poland and, using the GUS (State Statistical Bureau) household budget survey, calculates what portion of households' budget is absorbed by energy outlays for various socio-economic groups and at various income levels. Section 3 simulates the welfare losses and the actual income losses to different segments of the population from raising household energy prices. Section 4 examines the interaction of price policy and social policy, asking whether, and how, the impact of higher energy prices on the poor can be mitigated by a mixture of lifeline rates, cash subsidies for households or other methods such as in-kind transfers. Section 5 simulates the effects of lifeline pricing on household welfare adjustments.

I. Social Pricing Policy in the Transition Economies

Governments in the command economies used fixed low prices and wage controls as essential elements of their distributional tool-kit. Health services and education were free. As a part of the social contract, governments also provided many private goods, including subsidized dwellings, many urban services, transport, utilities, and sometimes food, at very low prices. In general, these attempts to remedy fundamental (or perceived) distributional problems through inefficient pricing of scarce resources has resulted in unsatisfactory improvement in income distribution while paying a high cost in efficiency terms.[2] Price controls may be a workable tool for redistribution -- but only if low income households consume more of the low-priced good. However, evidence of high income elasticities for many typically subsidized energy products in developing countries[3] suggest that price controls may actually be more regressive (Pindyck, pp 250). Evidence on income elasticities for energy in transition economies in generally is not available, but our work on Poland suggests that in Poland, income elasticities are even higher (about 1.6) than in the developing countries (section III).

Energy price adjustments in central European countries

As part of their stabilization and adjustment programs, transition economies are now being urged to correct public sector prices and to use national fiscal policies and targeted allowances and subsidies to achieve their distributional aims. Continuing with past pricing policies which made subsidies available to all implies significant leakages to the non-poor and represents a major fiscal cost. Nonetheless, public sector pricing is one of the last areas to be reformed in most of the transition countries. Price reforms have liberalized the prices of most goods in the private sector, and in particular, much progress has been made in adjusting prices of *tradeable* energy (Gray 1995). For example, oil, oil products, and hard coal[4] energy sources are tradeable products whose prices have for the most part been liberalized. However, adjusting prices for public services, especially for private goods provided by the public sector such as electricity, heat, housing rents, water, heating, and transport fares, has been more difficult.[5] In the domestic energy sectors in particular, such as electricity, gas,

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2/ For a review of the literature on this subject in developing countries, see Bird and Miller (1989) and Jimenez (1989).

3/ Income elasticities for energy products are higher in developing than in market economies (Pyndyck).

4/ Note exceptions in Poland, described below.

5/ Electricity strictly speaking is a *tradable* source of energy, but it tends to be treated (and priced) domestically without regard to international prices.

and heat, on average, there is still significant underpricing, especially on the household side.

The rationale for keeping prices low

There are several reasons for governments' reluctance to raise household energy prices. First is a concern over the impacts - direct and second round -- of higher energy prices on the overall price level, which will be a function of the structure of the economy and its energy intensity.[6] In addition, there is a reluctance to raise the *household* prices for fear of contributing to wage pressures and thus to inflation -- the counterpart of raising industrial prices for fear of the impact on production costs and in turn inflation. Ironically, if such price subsidies are significant in budgetary cost and if the resulting deficits are financed by money creation, then keeping prices too low may in fact be inflationary. Sometimes the overall level of energy prices may be kept low in an attempt to keep down surplus revenues flowing to the utilities (Gray 1995). Since the utilities typically have very low debt/equity ratios (most investment was financed by the budget), higher prices quickly translate into larger corporate cash-flows, and, in the absence of strong corporate governance and financial controls, there is concern over how such additional resources would be used by energy enterprises, which may be powerful and have significant autonomy. Finally, since there is presently excess energy capacity in the transition economies, as pointed out by Gray, "In most countries there is a lack of serious supply crisis (for domestically produced power, heat, gas and coal) and a lack of long-term enterprise debt problem. Politicians are not motivated by a supply crisis (i.e., the lights aren't going out)." (Gray 1995, page 36). The excess capacity also means there is, apparently, little immediate need for foreign investment that might supply new capacity and thus results in little "demand" for typical western pricing policies and the regulatory framework that accompanies this. The exception is Hungary which has made the most progress on pricing and regulation. Its success is due in part to a

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6/ NERA (1991) estimated that increasing domestic gas prices in Poland to border prices in 1990--an increase of more than 600% for households and 50% for industry--would result in an upper bound on the increase in inflation of about 4%. A lower bound on the inflationary impact on the CPI of total energy price increases is about 0.2 % for a 1 % increase in the overall price of energy (based on energy's share of household and industrial costs).

strategy offering to attract foreign investors to buy portions of utilities for cash so as to reduce its large fiscal deficit and foreign debt. Finally, there is a concern over the presumed social impact of such price rises -- the focus of this paper.

Current pricing approaches in transition economies

In many central European countries, even where the overall level of energy prices has been raised, the old socialist *price structure*, which subsidizes the residential consumer has been kept. As observed in Gray (1995, chapter 5), while, generally, wholesale prices cover the utilities' financial costs, the higher industrial price cross-subsidizes the lower household prices. Even where consumer prices are at or above industrial prices, as in Albania, Poland, and Hungary, they diverge to a greater degree from long run marginal cost than do the prices charged industrial users. This is the reverse of the marginal economic cost structure used in Western countries which typically prices energy to households *above* the cost to industry, inter alia, because of the higher costs of the household distribution system. Appendix tables 1 and 2 (Gray 1995, pg. 27-28) compare prices of electricity and gas in eastern Europe and OECD to estimates of LRMC. A commonly advanced hypothesis for this choice of price structure relates to the "soft budget constraint" on enterprises: higher energy prices for industry and the burdens such cross-subsidies might imply would be accommodated by the fisc, while the social contract required subsidies on the consumer side. In the west, concerns about international competitiveness would preclude such an approach.

In setting *price levels*, instead of using LRMC, most central European countries adopted an average cost pricing approach under which revenues would broadly cover financial costs (Gray 1995). Prices under this approach are generally lower than in western Europe: since assets are undervalued, debt in relation to equity is low, and depreciation rates are unrelated to the economic life of the assets, the financial "costs" (essentially operating cost and debt service) of the utilities will be artificially low [7]. Whether LRMC, which incorporates a long-range, forward-looking approach to calculating economic cost, represents the appropriate benchmark for setting the overall *level of prices* in the transition economies is sometimes debated (BOX 1). In the central European countries, uncertainties about demand growth and future investments raise legitimate questions about the immediate applicability of the LRMC model. That said, it may be appropriate to broaden the present approaches to the calculation of financial costs to include more forward looking estimates of the replacement cost of investments, with a view to enabling utilities to finance a sufficient portion of their future investments from internal cash generation and to pay dividends.

Recent price policies in Poland

While energy remains underpriced in many transition economies, all countries have by now made progress in bringing prices closer to *financial cost recovery* levels. In Poland, significant effort has been made towards increasing energy prices to more efficient levels. In the aftermath of the transition, in early 1990, a new pricing system for energy was introduced. Subsidies were to be eliminated over a four year period and the residential price of electricity rose three-fold in 1990 and then increased sharply again in 1991. Household prices of gas rose by somewhat less. District heat prices rose about three-fold from 1990 to 1991 (Meyers, Schipper and Salay, 1995 forthcoming, pp. 2-3). As a result, energy prices moved from a low level -- in some cases as low as 5 percent of economic levels[8] pre-transition -- to about 80 - 90 percent of economic costs for coal[9] and about 60 percent on

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7/ See Gray, 1995 for an excellent discussion of the impact of debt-equity ratios and other factors on the level of prices in utilities in central Europe in relation to neighboring countries in western Europe.

8/ Economic levels approximate long run marginal costs if the necessary investments which are needed to meet demand and environmental standards are included.

9/ To wholesale users. At the retail (household) level, the price of coal to households is *not* directly subsidized. However, there are at least four elements of *indirect* subsidy: (i) preferential VAT tax rate (7% instead of the normal 22%); (ii) overcapacity in mining has created a surplus, which has depressed prices on the free market. The overcapacity is artificially maintained through mine closure subsidies, which in reality are used to some (continued...)

Box 1 - What constitutes "efficient pricing?"

Long run marginal cost pricing has sometimes been taken as *the* benchmark for setting prices in the energy sector. Several characteristics of the energy sector in central Europe raise questions about the appropriateness of using LRMC (Gray 1995). Underlying the LRMC approach is an assumption that energy demand is growing and that future investment needs can be reliably forecasted. Neither is fully the case in the transition socialist economies.

Energy intensities, demand projections and investment needs. Energy demand is hard to predict in central Europe because there is so much room for improved efficiency in consumption. Energy intensity (energy consumption per unit of GDP) in central Europe is three to six times that of industrial or developing economies, and in Poland it is seven times higher than West Germany's (Meyers, Schipper and Salay, 1989). Energy consumption has declined in response to the sharp decline in GDP in the last few years, falling 24.7% from 1990 to 1993, similar to the decline in GDP (Box Table 1). Energy intensity has also declined since 1992. In Poland energy consumption has declined 23.2% since 1990, substantially reducing energy intensity. The main reason energy consumption decreased more than GDP in Poland is because of the fall in industrial output -- industry being the most energy intensive sector.

The continued contraction of energy intensive heavy industry and ongoing improvements in energy efficiency are expected to reduce energy intensity and further reduce growth in energy demand. These trends mean investment requirements for new capacity are likely to be small. Central Europe is thus different from other regions such as East Asia, where power demand is growing much faster than supply (Gray 1995, pg. 29).

Box Table 1: Percent change in energy consumption and GDP in transition economies

	1990	1991	1992	1993	Total
TSE Energy Consumption	-7.0	-9.0	-8.5	-2.7	-24.7
TSE GDP	-7.5	-10.0	-4.7	1.3	-21.7
Poland Energy Consumption	-19	-2	-4	0.8	-23.2
Poland GDP	-11.9	-7.6	1.5	3.8	-14.2

Sources: for all TSEs: Gray 1995; for Poland 1990-1991: Meyers, Schipper, Salay (1995 forthcoming); for Poland 1992-1993: Energy Information Center.

Environmental and rehabilitation investment. While central Europe may not need large new capacity investments, investment *is* needed to rehabilitate existing facilities and to make energy production environmentally cleaner. But, that timing is uncertain, depending e.g. on demands imposed by countries importing the transition economies' goods, and the implementation of stricter "European" environmental standards in TSEs (Gray, 1995).

In short, uncertainty about new capacity requirements and about when western environmental standards will be implemented makes it difficult to discern what investment costs LRMC price increases should in fact incorporate. What *is* certain is that utilities need to recover costs, including some "best guess" of future investment needs.

9/(...continued)
extent to have the mines survive longer; (iii) local retail prices do not reflect the full environmental costs of coal production. A study has estimated environmental costs to represent about 10% of present production costs; finally, (iv) local prices to households do not reflect the environmental costs of burning coal, as small users are not subject to standards, let alone fees or fines. Overall, the indirect subsidy on coal to retail (household) users may not be small.

average for network fuels such as power, gas, and heat as the transition took hold. In terms of industrial/household relativities, the structure of prices in Poland is closer to the economic cost structure (i.e., LRMC) than is that of the other central European countries (Gray 1995).

But further increases are still needed, if LRMC is taken as a benchmark (Table 2) for the longer term and especially if it is used as a benchmark for the relative household/industry price structure Taking tariff levels of 1993 as an example, average household *electricity* prices would need to be increased by *90 percent* to reach estimated long run marginal cost levels. The price of household *gas* needed to be increased by about *80 percent*. *District heat* is currently the most problematic to compare, as costs vary widely based on location: in the first six months of 1993 prices averaged Zl 140,000 /GJ, but ranged from Zl 60,000 to Zl 365,000 /GJ. On average, district heat prices needed to be increased by about *60 percent*. (Poland: Growth With Equity Policies For The 1990's, p. 89). More generally, even if the overall *level* of prices is based on financial criteria in the short run (moving to LRMC based in long run), the *structure* of prices is severely distorted. Since household prices should be set to reflect LRMC structure, this implies a need for very substantial household price increases.

Table 2: Poland - Price increases needed to bring energy prices to economic levels.

Energy Type:	District heat	Electricity	Gas
Req. price increase*	60%	90%	80%

Source: Poland: Growth with equity policies for the 1990's, 1994. * Based on 1993 prices.

Prices and consumption patterns

Residential use in Poland accounts for about 30 percent of total final energy use.[10] Coal has been the main source of households' primary energy in Poland for the last two

10/ See Meyers, Schipper and Salay, 1995 forthcoming. They find that 75-80% of use by "other customers" is residential and use by other customers accounts for 40 % of total final energy use. (pp. 1-3 and 5-2).

decades, though in part due to recent price increases its share is now declining (Meyers, Schipper, and Salay, 1995 forthcoming). Space heating accounts for the largest share of residential energy expenditures, in the form of coal, district heat, wood, and some electricity. This makes energy socially and politically important in the European and central Asian transition economies in a way that it is not in many other warmer climate developing countries. Without heat people will freeze.

Energy's Share in the Consumption Basket. These consumption patterns mean that any substantial increases energy prices will have a major impact on household energy expenditures. Aggregate figures show that even the impact of price increases to date has been significant. Outlays for electricity and heat accounted for between 2.5 percent and 4.9% of average monthly household expenditures of workers and retired persons, respectively, in 1985. In 1991, the shares doubled to 5.9% and 10 % (Meyers, Schipper, and Salay, 1995 forthcoming). By 1993, the respective proportions were 8.8 % and 11.7% -- a near tripling -- and the average energy expenditure for all households was 9.5%. This contrasts with the average share of energy in household budgets in western Europe of about 5 % -- although in the 1970s after the energy crisis and before demand adjustments took place, several countries had shares around 10 % (Pyndyck 1979). In developing countries, the average expenditure share of energy is higher and it is not unusual for energy expenditures as a share of income of the poor to be over 20 percent, even in countries where heat is not needed (Barnes 1994).

Household Price Elasticities of Demand. How hard is it for households to adjust their consumption to higher prices? There is little evidence of price elasticities for the transition economies. But a number of factors suggest that the elasticity of demand might be low in the short term, and certainly lower than in market economies, at least for some fuels. For example, for the most part, district heating is priced based on the square meters of apartment area. This implies that raising the price of district heat can have no effect on the quantity consumed by a given household -- unless the household moves apartments. But moving will not affect aggregate consumption of all households in the short term, since there will be no change in the housing stock.[11] Although users may wish to reduce district heat consumption, they cannot. The invariance of the quantity consumed to the price also means that there will be no incentive or ability for consumers to insulate houses and engage in activities to reduce the needed district heat quantities. Raising the price of coal on the other hand *will* have direct effects on consumption. This is evident from the fall in coal consumption after the price hikes in 1990. For power, the price elasticities may also be lower than in the market economies. Because of poor technology, appliances in the central European countries use much more electricity then their European counterparts. For example about 30 percent of the stock of TVs in Poland are old Polish-made black and white models which use more than three times as much as models imported from OECD countries (Poland: Household Budget Survey, 1993 and Meyers, Schipper, and Salay, 1994). In the last 20 years more homes have become owners of electrical appliances as well (Meyers, Schipper and Salay, 1994). Turning over this stock of out-dated and energy consuming appliances will take time, and until newer and more efficient ones replace them, one can expect price elasticities of demand to remain lower than in market economies.

In section III, we simulate the impacts of raising energy prices for the three major energy sources (district heat, electricity and gas) on a cross-section of household groups, under a range of assumptions about price elasticities. Our assumed range of price elasticities of demand for energy is between zero and minus one. This is based on estimates from previous work: Pindyck finds the long run elasticity for "energy" as a whole to be -1.1 in the U.S. and others have found similar estimates for many European nations, ranging from -0.28 to -1.7 (Pindyck p. 118). Estimates of own-price elasticities for *specific fuels* have led to more divergent results. Though the evidence is scant, price elasticities tend to be slightly lower in the developing countries than in the industrialized countries (Pindyck, p. 257). A survey of estimates of residential demand in three developing countries finds that long run price elasticities are slightly lower, averaging about -0.88 (Dahl 1991 p. 46). Both Pindyck

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11/ Over the long run, expenditures on housing and energy may fall: in this case there is more money to spend on other goods and utility may increase.

and Dahl also report higher income elasticities in the developing world than in the industrialized nations. Estimates of price elasticity of demand for electricity are in general lower than for all energy taken together. In general price elasticities range from -0.34 to -1.2, and appear to be lower in Europe than in the U.S.(Pindyck p. 120). Wilder and Willenborg compare their estimate to that of four other studies and found a similar range for price elasticities of -1.0 to -1.31.

II. Residential Energy Consumption in Poland -- Some Empirical Evidence

The purpose of this section is to answer some of the questions raised by the features of energy pricing and consumption patterns outlined above. First, who in Poland would be hurt and by how much if household energy prices were to rise to "efficient" levels? Second: How effective are Poland's present energy pricing policies at accomplishing Poland's social welfare goals?

Data and methodology

The data set used to carry out the empirical analysis in this section is the 1993 household budget survey. This data set consists of information on the expenditures of 16,044 Polish households surveyed between January and June 1993. Expenditure shares by income and social group are calculated as "per equivalent adult", based on the OECD scale (first adult = 1; other adults = 0.7; children aged under 14 = 0.5). The survey expenditure data has been weighted by socio-economic grouping to properly represent the composition of the nation. Regional price differences have also been accounted for by weighting expenditures (and income) according to a regional price index.

Total expenditures (rather than income) are used as a basis for this analysis. Due to widespread under-reporting of income in household survey instruments, total expenditures appear to be a better means of characterizing the well-being of the population than is reported income. Expenditure surveys thus also shed more light on household's poverty status. Often, the household surveys' reported income is biased because the survey methodology in use in the transition economies has not yet been adapted to the new economic structure. For example, when income and expenditures are compared in this survey, expenditures greatly exceed income for three hard-to-track groups: farmers, self-employed, and social income recipients. These groups operate to a greater degree in the informal or grey economy, and data are apparently less accessible to the survey gatherers - just as they are to the tax administration.[12]

Data on energy consumption was also collected as part of the Polish household budget survey. There is a small caveat as to its representativeness: The 1992/1993 winter was slightly warmer than average (Meyers, Schipper, and Salay, 1994) and the first six months of the year when the survey was conducted are in general warmer than the second six months, so that energy expenditure may be slightly lower in this sample than overall *(Understanding Poverty in Poland)*. Still, our concentration is primarily on the *distribution* of energy consumption among different groups in the population, and there is no reason to believe that this distribution is skewed in any way.

Who consumes the most energy in Poland?

Consumption by income group. The first important finding is that energy consumed a larger portion of the budget of the non-poor than of the poor (Table 3). While the poorest 20 percent of the population spent 7.4 percent of the their total expenditures on energy, the top 40 percent spent more than 10 percent. So, not only did the better off spend a larger absolute amount on energy than the poor, they also consumed a larger proportion of their expenditures as energy. This suggests there is a *positive and strong income elasticity* of energy demand (see below). This is different from the pattern in industrial market economies where evidence suggests that long-run income elasticities are close to unity (Pindyck 1979).

12/ See *Understanding Poverty in Poland*, World Bank 1995 for a further description of the survey.

Table 3: Energy as a percent of total expenditures, by expenditure class

Expenditure quintile	District heat	Electricity	Gas	Major energy sources	Residential coal	Wood	Hot water	All energy
1 (poorest)	1.5	3.6	1.3	7.6	0.4	0.2	0.4	**7.4**
2	2.2	3.4	1.7	8.0	0.8	0.3	0.6	9.0
3	2.6	3.5	2.0	8.1	1.3	0.3	0.6	10.2
4	2.6	3.2	2.2	7.3	2.1	0.2	0.6	**10.8**
5 (richest)	2.2	2.7	2.7	6.4	2.5	0.1	0.5	**10.3**
All	2.2	3.3	1.9	7.4	1.4	0.2	0.5	9.5

Source: Authors' calculations from Poland Household Budget Survey, 1993.

To get an idea of what this means in terms of actual household expenditures, consider that total average monthly expenditures on energy for each group are as follows: the first quintile spent Zl 1,117,740; the second, Zl 1,719,450; the third, Zl 2,176,800; the fourth, Zl 2,782,530; and the fifth quintile spent on average Zl 4,729,200 per month. Overall, average monthly household expenditures were Zl 2,517,660 per person. Taking the average annual exchange rate in 1993 of Zl 18,145, the bottom quintile spent Zl 82,712 or about US$ 4.6 on fuel while the top quintile spent Zl 487,108 or about US$ 26.8 on energy, more than 5 times as much as the bottom quintile.

In terms of the main forms of subsidized energy (district heat, electricity and gas) consumption patterns are distributed somewhat more similarly to income (implying that any subsidies are only slightly regressive). Most of the regressiveness of the energy subsidy is due to gas (the rich consume twice as much as the poor). The subsidy on electricity is flat, except for the highest income group, and on district heat, it is distributed in a u-shaped fashion.

Income elasticities. A rough guess at income elasticity can be made simply by looking at the percentage change in energy consumption divided by the percentage change income (Table 4). This rough calculation shows the income elasticity to be between 1 and 2. Looking closely, this result is generated primarily by gas -- the rich consumed about twice as much as a proportion of their expenditures as the poor (2.7 percent of their budget as compared to 1.3 percent) -- and heat consumption -- where the fifth quintile consumed about 2.3 times more than the poorest quintile[13] (Table 3). This implies that price controls in the energy sector, especially those on gas and district heat are regressive and hence involve a lot of "leakage" of the price subsidy to the non-poor in social welfare terms.

Table 4: Poland- Estimated Income Elasticity of Energy Demand

expenditure group	percentage change in energy expenditures	percentage change in income	income elasticity
1 to 2	0.73	0.46	1.60
2 to 3	0.44	0.27	1.65
3 to 4	0.35	0.27	1.26
4 to 5	0.51	0.70	0.73

Source: Authors' calculation from Poland Household Budget Survey, 1993.

Consumption by socio-economic group. The second main finding comes from examining energy budget shares for different social welfare groups (Table 5). There are notable differences in energy expenditures among different socioeconomic groups. Pensioners spent a significantly larger share of expenditures on energy (11.7%) than any other group. This is consistent with the stylized fact that in transition economies, pensioners tend to be "house rich and income poor", especially in urban areas. Heating and lighting their relatively large apartments and houses thus places a greater burden on them (8.8% of total expenditures) than on other groups (6.9% for all groups taken together). Also evident is the different types of energy each segment of the population uses. Farmers and mixed families use coal and wood for heating more than other groups. This is a

13/ "Heat consumption" is comprised of both district heat (Table 3 col. 1) and residential coal use (Table 3 col. 4). As shown in table 3, the lowest quintile spends 1.9 percent of its budget on heat, while the richest quintile spends 4.7 percent of its budget.

significant finding because while the price of coal is hardly regulated, district heating is still highly subsidized to consumers (Meyers, Schipper and Salay, 1994, p. 2-3; World Bank 1994). This implies that workers, pensioners, self-employed and social transfer recipients are benefitting much more from energy price controls than are other groups such as farmers or mixed households (Table 5). All groups but farmers and mixed households spend about 8% of their income on subsidized items proportionately, (and, by implication, receive that much, in terms of subsidy). Farmers and workers spend only 4% of their income. Subsidization of self-employed is particularly high, since their income is higher than other groups and they spend almost as much as pensioners, the top-spending group. There are clearly also regional effects since urban areas use district heating while rural areas are more dependent on coal and wood. In sum, the subsidies benefit urban households.

Table 5: Energy expenditure as a percentage of total expenditure by social welfare group

Social Welfare Group	Heat	Electricity	Gas	Major energy sources	Coal	Wood	Hot water	All energy[a]
Worker	2.7	3.0	1.9	7.6	0.5	0.1	0.8	8.8
Farmer	--	3.2	0.7	3.9	2.2	0.6	--	6.7
Mixed	--	2.9	1.2	4.1	2.0	0.4	--	6.4
Pensioner	2.5	3.7	2.2	8.4	2.6	0.3	0.4	**11.7**
Self-employed	2.1	3.4	2.5	7.7	0.3	--	0.6	8.9
Soc. Recipient	2.1	4.0	1.7	7.8	0.5	0.3	0.5	9.0
All	2.2	3.3	1.9	7.4	1.4	0.2	0.5	**9.5**

a/ May not sum due to rounding. Note: "--" Spent less than 0.05 % of budget.
Source: Household budget survey.

While farmers and mixed households consumed much less district heat than most households, they also used more wood than the others. Interestingly, a large portion of the wood consumed was actually free; of the wood consumed by farmers and mixed households about two-thirds of it was free. Meyers, Shipper and Salay (1995 forthcoming) found that when the price of coal rose in 1990, coal consumption dropped significantly, there was evidence that people consumed coal stored from the previous year and also switched to wood consumption.

Consumption Patterns by Employment Status. There are no significant differences between the long-term unemployed and the not long-term unemployed in terms of energy consumption (Table 6). Their consumption is broadly the same as the population at large taken together -- 9.5% of expenditures. Consumption of subsidized energy is slightly higher among the long term unemployed (7.6% vs 7.4% of spending).

Table 6: Poland - Energy as a percentage of total expenditure by employment class

Employment category	Heat	Electricity	Gas	Major energy sources	All energy
Long term Unemployed[a]	2.0	3.7	1.9	7.6	9.2
Not-long term Unemployed	2.2	3.3	1.9	7.4	9.5

a/ Defined as households with one or more members who have been unemployed for more than one year.
Source: Poland Household Budget Survey.

Special problems in raising household energy prices in transition economies

Income decline and fixed incomes. There are unique problems in the former socialist economies in adjusting household energy prices. First, incomes have fallen over the transition -- in some countries by 30 percent or more since 1989 -- and poverty has increased (Milanovic, 1996 forthcoming). Where the poverty incidence used to be 2-4 percent before the transition it is now upwards of 15 percent. Unemployment levels are at historically high levels and in some countries five times higher than in the pre-transition period, and a larger fraction of the population than in the market economies are on fixed incomes (and hence vulnerable to inflation), judging by the higher system dependency rates of their social security pension systems. Indeed, in Poland, some 22 percent of the Polish population, and fully 49 percent of the labor force receive (fixed) pensions, while in the United States the equivalent figures are 16 percent and 32 percent.

Non-marginal price increases. Second and perhaps more important, prices often have to be increased substantially -- by a multiple of the controlled price rather than by only a small percentage. These factors alone would make raising prices politically challenging. But there are further complications. First, it is often not just the price of *one* energy source or utility that needs adjusting, but *many* public sector prices -- transport, rents, power, gas, water, heat. Jointly, these can add up to a significant proportion of household incomes, and there would be major income effects if the price increases were to take place simultaneously. Rent increases are likely to be especially burdensome, since housing is generally thought to be highly underpriced (Renaud). In addition, the still relatively large share of non-cash earnings in workers' total compensation package in some countries -- most notably enterprise-provided housing and social services[14] -- means households have less truly disposable income than in market economies. While some countries have moved in the direction of charging for social services, the high payroll taxes used to fund them also reduce the discretionary spending envelope available for necessities, as compared to market economies, so that increases in energy/utility prices are keenly felt, since they reduce this small discretionary envelope even further. And, third, the socialist legacy has left people with a feeling of entitlement to free or subsidized goods.

A rapid adjustment of household energy and utility prices -- especially if combined with increases in other public sector prices, such as rent and transport -- would imply significant changes in the cost of living and in welfare (Table 7). Thus, changing public sector prices will likely result in large and unpopular distributional shifts if not properly managed. Such shifts could upset the fragile democracies that are emerging in the transition countries. As shown in Table 7, utilities in the energy sector absorbed almost 10 percent of total household expenditures in Poland in 1993. If transport and communication are included this total reaches about 16 percent of household

14/ There is some data in the Household Budget Survey on the non-cash component of compensation but it is not reliable because, inter alia, pricing non-cash items is difficult. What has been reported is in the range of 5% - 10% but it is probably an underestimate since many households did not respond on this item.

expenditures. Including rents -- even at their generally low levels -- brings the total up to 18.2%.[15]

Table 7: Poland - Transport, communication, and rent as percent of total expenditures

quintile	total energy	transport and communication	rent	total utilities transport and rent
1 (poorest)	7.4	4.3	2.2	13.9
2	9.0	5.1	2.6	16.7
3	10.2	5.9	2.7	18.8
4	10.8	6.7	2.6	20.1
5 (richest)	10.3	9.0	2.2	21.5
All	9.5	6.2	2.5	18.2

Source: Authors' calculations from Poland Household Budget Survey.

III. Raising Energy Prices: Who Loses and by How Much?

There are three types of effects on households associated with higher household energy prices: First, there are the *direct* effects on the consumption and welfare of household consumers; these depend on the share of energy in total budgets and its substitutability with other fuels and with other goods. These costs will be higher in the short run than in the long run. Second, the *indirect* effects resulting from higher revenues for utilities that permit needed investments, allowing producers to become more efficient and to provide cleaner energy, both of which benefit consumers.

15/ An important related issue is that of sequencing of the various price adjustments. One factor in determining appropriate sequencing is the substitutability/cross price elasticity of various energy sources or services. This is particularly important in energy, as relative household energy prices should ideally be adjusted together to minimize allocative efficiency distortions (i.e, one should attempt to maintain the differences between prices which reflect differences between economic cost). This avoids serious mispricing of one fuel relative to another which would encourage the wrong type of interfuel substitution in the long-run. Other factors affecting sequencing are likely to be country specific, given the rate of growth of demand, country specific cost structure and overcapacity/undercapacity conditions.

And, third, are the macro impacts. These relate to the effects of higher prices (and reduced subsidies) on government expenditures and revenues. There may also be general price level effects, and a change in the composition of aggregate output. In this paper we concentrate solely on the first type of effect, the *direct effect on households*.

Measuring welfare losses

To determine the size of the *welfare losses* associated with increasing the price of energy from their 1993 levels, we calculated the loss in consumer surplus as a percentage of total expenditures based on a range of price elasticities from zero -- assuming no change in consumption following a price rise -- to minus one -- assuming a proportional decline in consumption.

The welfare loss is calculated as the loss in consumer surplus from the price change: it is the *additional* amount of money that the consumer pays for all of the energy that he continues to consume at P_1, the new higher price, (area A) plus the amount he would be willing to pay above the old price (P_0) to consume the old quantity (area B in figure 1).[16]

The change in consumer surplus (ΔCS) can be written as:

$$\Delta CS = Q_0(p_1-p_0)(1 + \epsilon(p_1-p_0)/2p_0)$$

Where Q is quantity, p is price, ϵ is the price elasticity of demand, the subscript 0 refers to the period before the price change, and the subscript 1 refers to the period after the price change. So, the change in consumer surplus as a percentage of the budget is:

$$\Delta CS/E = [Q_0(p_1-p_0)/E](1 + \epsilon(p_1-p_0)/2p_0)$$
$$= S_0[(p_1-p_0)/p_0](1 + \epsilon(p_1-p_0)/2p_0)$$

where S is the budget share of energy (Q*p)/E.

This is represented graphically by the shaded areas A and B: the actual increase in energy

16/ Ideally we would look at the amount of income the consumer would need given the new price structure to be as well off as he was before. That is, the amount of cash it would take to get the consumer on the compensated demand curve, but of course in practice this is very difficult to determine.

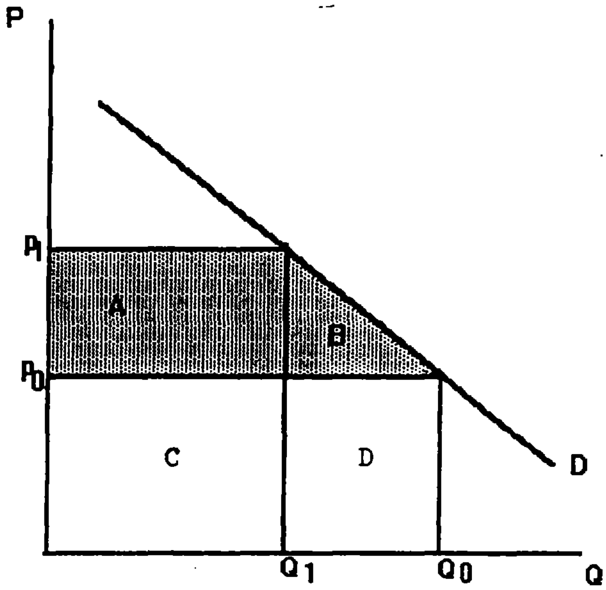

Figure 1

outlays that takes place as a result of the price rise from P_0 to P_1 (A), plus the loss in consumer surplus as a result of the price increase and corresponding demand response in consumption (B). All losses in consumer surplus in this paper are calculated as a percentage of total expenditures (Areas (A+B)/Expenditures)).

Calculating welfare losses. We estimated the welfare loss associated with various different price changes (Table 8). For illustrative purposes, the effects on different income groups of an 80% increase in energy prices is outlined -- an increase not deemed unrealistic in terms of what is needed for energy prices, overall, to reach "efficient" levels, as outlined in section II (Table 2).

Additional simulations are presented in Appendix tables 3 - 7 which show the welfare loss effects of price increases ranging from 20% to 120%. As the additional simulations show, the welfare loss corresponding to a *zero elasticity is linear with respect to the price change*, so the welfare loss associated with a 80% price increase would be twice that associated with a 40% price rise. For other elasticities (less than zero) the welfare loss will increase less than proportionately in prices because of the effect of the second term in the equation which is squared in the price change. That is, when demand is elastic, a price increase of 80% will be associated with *less than twice* the welfare loss of a 40 % price rise.

Who hurts most?

As would be expected from looking at the share of energy consumption by various income groups, *the welfare loss of higher energy prices is greater for the non-poor than for the poor.*[17] Assuming a zero elasticity of demand, the poor's welfare declines by 5.9%, while that of the richest quintile declines by 8.2% (Table 8). For all consumers taken together, the welfare loss associated with an 80% increase in prices is between 4.6% and 7.6 % of their total budget, depending on the price elasticity of demand that is assumed --the more elastic is demand, the less the welfare loss.

17/ We define "poor", as the lowest quintile and non-poor as all those above that level. Preliminary results from the *poverty assessment* for Hungary indicate that the poverty headcount for Hungary is less than 20%.

Table 8: Effects on household budgets of increasing energy prices by 80%. (loss in consumer surplus as percentage of total expenditures).

Category	Heat			Electricity			Gas			All energy		
Elasticity	0	-.5	-1	0	-.5	-1	0	-.5	-1	0	-.5	-1
1 (poorest)	**1.2**	1.0	.7	**2.9**	2.3	1.7	**1.1**	.8	.6	5.9	4.7	3.5
2	1.7	1.4	1.0	2.8	2.2	1.7	1.3	1.1	.8	7.2	5.7	4.3
3	2.1	1.6	1.2	2.8	2.2	1.7	1.6	1.3	1.0	8.1	6.5	4.9
4	2.1	1.6	1.2	2.6	2.0	1.5	1.7	1.4	1.0	8.6	6.9	5.2
5 (richest)	1.8	1.4	1.1	2.2	1.7	1.3	1.8	1.4	1.1	8.2	6.6	4.9
All	**1.7**	1.4	1.0	**2.6**	2.1	1.6	**1.5**	1.2	.9	7.6	6.1	4.6

Source: Authors' simulations.

In terms of *type of energy*, the welfare loss to all consumers of raising *electricity prices* is much higher than for other fuels, given its generally larger share in overall consumption. Assuming no change in consumption, raising power prices gives rise to a welfare loss equal to 2.6 percent of total budgets, compared to 1.7 percent for district heat and 1.5 percent for gas. However the impact on the poor is especially notable. Raising power prices affects the poor more than raising the prices of other types of energy. The poor incur welfare losses equal to 2.9 percent when power prices are raised, compared to 1.2 percent for heat and 1.1 for gas.

In terms of *socio-economic group* and occupation, farmers and mixed families are hurt the least by an overall 80% increase in the price of energy --largely because they do not consume district heat. Assuming a zero elasticity of demand, their welfare drops by about 5.2%, while pensioners are hurt the most -- 9.4%. Workers are also hurt significantly -- 7.1%. These results suggest that the "constituency" for keeping prices low --workers and pensioners -- is quite large in Poland and that there may be a major political dimension to raising prices in Poland.

Table 9: Effects on Socio-economic groups of increasing energy prices by 80% (loss in consumer surplus as percentage of total expenditures)

Group	Heat			Electricity			Gas			All energy		
Elasticity	0	-.5	-1	0	-.5	-1	0	-.5	-1	0	-.5	-1
worker	2.1	1.7	1.3	2.4	1.9	1.4	1.5	1.2	.9	7.1	5.7	4.2
farmer	0.0	0.0	0.0	2.5	2.0	1.5	.6	.4	.3	**5.3**	4.3	3.2
mixed	0.0	0.0	0.0	2.3	1.8	1.4	1.0	.8	.6	**5.1**	4.1	3.1
pensioner	2.0	1.6	1.2	2.9	2.3	1.8	1.8	1.4	1.1	**9.4**	7.5	5.6
self-employed	1.7	1.3	1.0	2.7	2.2	1.6	2.0	1.6	1.2	**7.1**	5.7	4.3
soc. recipient	1.7	1.3	1.0	3.2	2.6	1.9	1.4	1.1	.8	7.2	5.8	4.3

Source: Authors' simulations.

The effects of price increases on household budgets

It is also interesting to measure the direct impact of a change in energy prices on household *budgets* (as distinct from household welfare). Table 10 shows the simulated results for different income groups and socioeconomic groups. Visually, from figure 1, the impact of the price increase is measured as (A + C) - (C + D) = A - D. Arithmetically, the change in expenditure is equivalent to $S_0(P_1\text{-}P_0/P_0)[\epsilon + \epsilon(P_1\text{-}P_0/P_0) + 1]$. Table 10 indicates the *increase* (or decrease) in household spending, due to a price rise. Where the price elasticity is -1 or greater, the simulations show a "positive effect" on household spending, (i.e. a negative change, and a reduction in budgetary outlays) which implies that the substitution effect dominates the income effect and that less will be spent on energy after the prices rises because of the decline in consumption. Where the price elasticity is zero or -0.5, the impact on the budget is deleterious -- in other words, households spend *more* after the price change than before.

Table 10: Change in actual expenditures on energy for an 80 % price increase

(percent of total expenditures)

income group	Elasticity 0				Elasticity -0.5				Elasticity -1			
	district heat	electricity	gas	all energy	district heat	electricity	gas	all energy	heat	electricity	gas	all energy
1 (poorest)	1.20	2.88	1.04	**5.92**	0.12	0.29	0.10	0.59	-0.96	-2.30	-0.83	-4.74
2	1.76	2.72	1.36	7.20	0.18	0.27	0.14	0.72	-1.41	-2.18	-1.09	-5.76
3	2.08	2.80	1.60	8.16	0.21	0.28	0.16	0.82	-1.66	-2.24	-1.28	-6.53
4	2.08	2.56	1.76	**8.64**	0.21	0.26	0.18	0.86	-1.66	-2.05	-1.41	-6.91
5 (richest)	1.76	2.16	2.16	8.24	0.18	0.22	0.22	0.82	-1.41	-1.73	-1.73	-6.59
worker	2.16	2.40	1.52	7.04	0.22	0.24	0.15	0.70	-1.72	-1.92	-1.22	-5.63
farmer	0	2.56	0.56	5.36	0.00	0.26	0.06	0.54	0.00	-2.05	-0.45	-4.29
mixed	0	2.32	0.96	5.12	0.00	0.23	0.10	0.51	0.00	-1.86	-0.77	-4.10
pensioner	2	2.96	1.76	**9.36**	0.20	0.30	0.18	0.94	-1.60	-2.36	-1.41	-7.49
self-employed	1.68	2.72	2.00	7.12	0.17	0.28	0.20	0.71	-1.34	-2.18	-1.6	-5.70
social recipient	1.68	3.2	1.36	7.2	0.17	0.32	0.14	0.72	-1.34	-2.56	-1.09	-5.76
all groups	1.76	2.64	1.52	7.60	0.18	0.26	0.15	0.76	-1.41	-2.11	-1.22	-6.08

Note: A positive number indicates that a *larger share* of total expenditures will be spent on that energy category after the price rise than was spent before. In other words, the *income effect dominates*. (A negative number implies that the *substitution effect* dominates and that *less* will be spent on energy after the prices rises because of the decline in consumption). Each entry is calculated as (A+C) - (C+D) = A-D from figure 1, the actual calculation is: change in expenditure = $S_0(P_1\text{-}P_0/P_0)[\epsilon + \epsilon(P_1\text{-}P_0/P_0) + 1]$.

As for effects on *income groups,* assuming a zero elasticity, the largest impact of higher energy prices over all is felt by the second-richest quintile who would see their energy outlays rise by 8.64 percentage points from 10.8 percent of their expenditures to 19.64 percent of their expenditures. For the poorest quintile, the increase is 5.9 percentage points from 7.4 percent total outlays to 13.3 percent.

Among *types of energy*, the budgetary impact of higher prices is greatest for electricity. And, the impact of raising *electricity* prices is *hardest on the poor.*

Amongst *socioeconomic categories*, higher energy prices affect pensioners the most, increasing their energy expenditures by 9.3 percentage points, from 11.7 percent to 21.0 percent of their total spending.

Some implications: addressing the social consequences of price increases

This type of incidence/impact analysis can be used to help guide governments in determining who is affected most, and in determining the amount of compensation households would need, if governments were to decide to try and offset welfare losses or financial costs to households from price increases. This analysis suggests if energy pricing policy is going to be used as a means to "redistribute income", *electricity* is probably the best fuel medium. First, increased electricity prices hurt the poor more than increases of other energy prices. Second, the non-poor (rich) consume absolutely more electricity than do the poor, so the subsidy on power benefits them, and raising power prices would be progressive in its impact. Explicitly subsidizing electricity prices to help the poor however, raises the question of interfuel substitution. If families can substitute away from other fuel sources toward electricity, this will have seriously distorting effects. One way to alleviate this problem is by offering lifeline pricing for a small quantity of electricity only. This option is discussed in the next section, and its welfare effects simulated in Section V.

Although all users will lose consumer surplus if prices are increased, their actual expenditures on energy may rise or fall because of the higher prices (see table 10). If elasticities are low, consumers will not be able to shift consumption away from energy, and expenditures will increase (In figure 1, A will be larger than D). If elasticities are high, then the substitution effect will dominate and consumers will reduce their consumption of energy more than enough to offset the price change (A will be smaller than D). In the short run, expenditures will probably rise as demand may be inelastic, but in the long-run price rises should be accompanied by real energy savings.

What the analysis does not imply

The calculations of the welfare and budgetary costs to consumers from increasing energy prices presented here should *not* be taken to suggest that increasing energy prices would be too "costly" to society and that efficient pricing policies should not be pursued. *On the contrary*, these figures are presented to be a guide for the short-run welfare implications to the population, and to help structure the least socially costly means of implementing price increases (see section V). Also, it should be kept in mind that the long run benefits from removing price controls are likely to far outweigh the costs. Continuing to subsidize energy will encourage consumers to buy more energy-intensive appliances and to over-use energy. Thus, if prices remain low, demand will increase, which will in turn strain the inefficient generating plants and transmission companies whose costs are well above prices. Financing price subsidies has a budgetary cost and crowds out other priority spending. Subsidies, if too costly, will contribute to budget deficits with consequent inflationary repercussions.

IV. Social Pricing Mechanisms: A Buffer for Households?

Raising public sector prices and user charges to the appropriate levels may require special transitional approaches and pricing mechanisms to offset the social costs to low income households. If well-designed, such schemes would facilitate cost recovery by the utility and allocative efficiency while at the same time cushioning the impact on incomes, thereby facilitating the price rise. A number of approaches could be considered including: lifeline rates, vouchers, increasing social assistance payments, and general adjustments to wages and pensions.[18]

"Lifeline" rates

Lifeline rates which set prices for small volumes of consumption at low levels, and "senior citizen rates", which provide pensioners on fixed incomes with low-cost energy, are often used to alleviate the social cost of raising energy prices to the low-income population. They may also help make energy price reforms more politically palatable -- depending on what income groups represent the constituency for low prices. Lifeline pricing is administered by the utilities which provide discounted prices to consumers for a single "needed" block of energy while charging full price for any consumption of excess energy over the limited lifeline block. Single (as distinct from multiple) block pricing has the advantage of simplicity: everyone gets to consume a certain amount of energy at a low price. But block rates involve "leakages", that is, the consumption of the non-poor is still subsidized.[19] Alternative solutions that try to target lifeline price subsidies based on means-testing (or other targeting mechanisms) would clearly be administratively more complex. For example, the block rate could be given only to the "certified poor". But this may be administratively too complicated (it would require identifying the eligible poor and integrating this information into the utilities' billing systems). And, although it appears leakage-free, a growing gray economy and inadequate means-testing suggests that it is not (we have seen that household budget surveys significantly under report income). Thus, targeted bloc rates are imperfect in a transition economy and probably not cost effective. Finally, providing lifeline rates (unless the utility receives compensation from the budget implies a cost to the utility that will affect the utility's cost recovery. Ideally, lifeline subsidies would be compensated from the budget, and not financed internally by the utility itself through cross-subsidies that are inefficient, unfairly tax the higher priced consumer (usually industry) and thereby distort industrial growth and employment.

18/ Bahl and Linn 1992.

19/ To avoid this problem, the energy tariff on consumption after the first block, could be set ***above*** the long run marginal cost so that the average price to consumers of large quantities is roughly the efficient price.

Multiple block rates with a "lowest" lifeline rate and a "lower" rate for the next increment in consumption can be used to protect both poor *and* middle income consumers from the effects of price increases. They are, however, more administratively complex than single block rates. And they might lead to more distortions if each group consumes electricity at different prices, since each also has a different marginal rate of substitution between electricity and other goods and between electricity and other types of energy. If the goal is to protect the middle class, then using a *larger single block* may be more efficient than two or three blocks. This would however involve greater leakages, larger subsidy costs, and less incentive to conserve.

To reduce the leakage problem and to help finance the subsidies to poor customers consuming the first low-price bloc, rates can be raised for non-subsidized consumers or for all customers who consume more than the first block. Lifeline rates implemented in this fashion should thus redistribute income. But before adopting such a scheme to redistribute income, regulators should consider how eligible customers value the subsidies they receive; what distortions and equity efforts are created, and how the costs of lifeline pricing compare to costs of other distributive programs (Scott 1981). We simulate the equity effects of the lifeline pricing option, compared to smaller, but across the board price increases, in section V, and find them to be more equitable.

Implementing lifeline rates in transition economies

Instituting a lifeline program -- in any country -- requires deciding: (i) the amount of consumption (e.g. number of kilowatt hours) to be included in initial block; (ii) price per unit of energy (kilowatt hour) of lifeline block and succeeding blocks; and (iii) the number of customers who will qualify. For power, the caveats were noted above: lifeline pricing is feasible, but has shortcomings because of the leakages to the non-poor, and costs to the utility if lower priced power sales are not compensated by the budget.

There are, however, some problems specific to the transition economies of administering a lifeline system. For district heating, for example, the lack of a metering system in many transition economies makes such a scheme quite problematic. In most countries, district heat is charged to the whole building and then attributed to households on the basis of square meters of floor space. Although lifeline pricing of heat could be instituted by charging a lower rate per square meter for small apartments than for larger apartments, no positive conservation incentives would be generated and targeting based on house/or apartment size is not likely to be efficient nor to meet equity objectives: there is no evidence to suggest that house size is a good proxy for income level. (The reverse might even be the case for, e.g., pensioners who are typically poor but "house-rich" in the transition economies). Since there is almost no housing mobility in Poland, families cannot even move to reduce costs and some poor families occupying large houses may be forced to pay more when prices rise. Another approach would be to compensate only the certified poor for a quantity of heat that corresponds to e.g. 20 square meters of floor space. Here again, since the poor cannot adjust their consumption or limit it to the lifeline quantity, this approach would also unfairly burden them. On the other side, the inelasticity of district heat demand to a change in price, there is little efficiency loss from a lifeline heat subsidy. But as evidenced from the distribution of consumption (Tables 3 and 4) it is a poorly targeted subsidy -- the rich consume more of the subsidized good as a percentage of their income than the poor. Consumption data also implies that lifeline pricing for heat would also exclude some of the needy: farmers and worker-farmer (mixed) households make up almost 30 percent of the very poor[20] yet they do not consume district heat and would therefore not benefit from the subsidy (Table 5). Thus, lifeline pricing makes most sense for electricity.

Vouchers

Vouchers, which could be administered by government or local social assistance offices, could be given to the eligible poor following price increases, entitling them to the purchase of a certain amount of energy at a fixed price. In principle, vouchers are more flexible than lifeline rates in that they allow some differentiation between households based on size and composition (the bloc rate would apply to the "billing address" regardless of how many consumers were present). By contrast, vouchers can be given to only the poor, assuming these can be identified. Thus the

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20/ *Understanding Poverty in Poland*, p.17. The very poor are defined as families with income below the minimum pension.

problems of a targeted lifeline program for the certified poor apply here as well. In a growing gray economy, means testing is harder and harder to do -- and a voucher system is clearly more administratively cumbersome than bloc rates administered by the utility. Finally, like lifeline rates, targeted vouchers interfere with allocative efficiency by impeding the response of voucher recipients to higher prices -- i.e. they impede the operation of the substitution effect[21]. If energy vouchers are given, consumers will use the entire voucher-eligible quantity, or will consume up to the point where the marginal value of consumption is equal to the lower fixed (voucher-eligible) price (assuming there is no trade in vouchers). In addition, trade in vouchers could raise a whole new set of issues. Selling vouchers would make them akin to cash grants for the poor (see below), except that the non-poor who buy the vouchers would also benefit from the cheaper energy (although of course they would pay for the voucher). On the positive side, a properly designed voucher program (that compensates the utility for each unit of underpriced energy) puts the subsidy where it belongs -- on the budget -- and not on the financial statement of the utility.

Targeted cash payments for the poor

Cash payments provided to the eligible poor through the social assistance system would lead to a more efficient allocation of consumption of goods and services than vouchers, since the poor consumers face market prices. They also protect the utilities' cash flows.[22] Targeted specific cash payments could be used to increase households minimum income or given to "at risk" groups through the social assistance system, at the same time as prices move to efficient levels. In Bulgaria, for example, a scheme is in place to compensate poor households for higher electricity prices. Under the Bulgarian approach, households are grouped into three categories, by income, and a predetermined subsidy (transfer) is paid to each group of households; the subsidy declines, as income goes up. Households in the poorest group are more or less totally compensated for their (estimated) power consumption, while better off households receive far less. One advantage of this

21/ We have noted that the response in transition economies may be muted for certain types of energy.

22/ See Milanovic (1995) for an excellent discussion of the pros and cons of different types of cash and in-kind transfers.

scheme is that it encourages efficient consumption, since if poor households consume less than the subsidy, then their net income is higher.

Cash payments to compensate for specific price increases to at risk groups work best if there is an effective social assistance program already in place and the number of households in need of assistance is small. Then they are fiscally affordable and means-testing (or otherwise targeting) is feasible. If large groups qualify then they may become administratively burdensome, and fiscally expensive. Some countries in eastern Europe have assigned local governments responsibilities for social welfare. Where this is the case, such as in Hungary, Albania, and Poland, local social assistance offices might be reasonably well equipped for the task of *distributing* (but not necessarily financing) targeted cash payments. How much compensation -- full or partial as in Bulgaria -- and for how long[23] would all need to be decided.

Providing the cash compensation for energy price rises by increasing some guaranteed minimum levels of income could be another approach. This would involve raising e.g., social assistance payments proportionately with the increase in energy rates. As for targeted cash payments, this would require estimating the weight of utilities in the consumer basket so that coefficients for compensation can be found, and would require a decision about how much compensation to offer. While technically feasible, depending on how much compensation is offered, and for which utilities, this may become expensive. (Indeed, presently, the subsistence minimum baskets now used to identify the poor in transition economies often exclude rents and sometimes exclude utilities).

In-kind transfers

In principal, transfers in *cash* are more efficient than transfers in kind, but the transfer of "tied" social assistance is often politically more acceptable and therefore the more attractive

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23/ This could in part be related to the relative magnitudes of the long term and short term price elasticities of demand.

alternative. (Food stamps in the U.S. are an example). (A caveat would be where this approach could lead to the emergence of multiple in-kind transfer schemes (e.g. for transport, electricity, heat, etc. To that extent, a single cash transfer through the social welfare scheme might be administratively simpler).

Targeted transfers in-kind would operate as follows: the social assistance office would first establish that a person/consumer is poor. Then, the social assistance office would pay the heating/power bill *directly* to the heating or utilities company. The target beneficiary never sees the money. Thus, the transfer cannot be used for anything else--it is thus analogous to giving a given quantity of heating to each target beneficiary for free. In the case of district heat in Latvia, Milanovic (1995) argues against blanket subsidies and has recommended that poor households be compensated via such heat allowances targeted to the very poor.

Such an in-kind transfer can be calibrated in various ways. Milanovic (1995) distinguishes between two approaches: one that calibrates the in-kind transfer on the basis of a recipient's *net (of higher utility costs) income,* or, alternatively, calibrating the transfer on the basis of the recipient's *gross income* level. Where metering is *not* possible (i.e. consumption is invariant to price), and there are sizable differences in utility costs across regions, the recommended approach is to compensate all households whose income *after* the payment of heating costs (i.e., *income net* of utility outlay) is less than some pre-determined poverty line. If metering is available and households *can* change their heat consumption, compensation on the basis of net income may cause them to increase heat consumption and, thereby, increase their net income, inclusive of subsidy. Thus, an alternative, where metering *is* possible, is to compensate all households whose gross income is below a certain level, for all, or some, of their utility costs.

Determining who is eligible: the data limitations. If the intent is only to give compensation to "at risk" groups, this may require the development of new information and tracking systems. Some observers think that effective targeting will be relatively easy in the transition economies because of the large "command and control" data base that existed in these countries. This hope may be naive, however, since these data bases were not typically designed to focus on income-testing -- rather they served as police files. And, where household surveys have been undertaken, substantial flaws appear to exist in these data bases - in Poland several million people seem to be "off the books"; Hungary and Slovakia have important low-income ethnic groups that are similarly elusive; consumption and income data diverge significantly. Recent household expenditure and income surveys show how flawed some of the data are, and how much improvement is needed. In the interim, imperfect targeting methods -- whether based on imperfectly measured income -- or proxies for income, may have to be used.

General wage or pension increases

Increasing wages, pensions, unemployment benefits or other fixed incomes across-the-board will benefit all energy consumers, not just the poor, and is likely to have inflationary and budgetary costs. Judged from the perspective of targeting, the leakages to the non-poor are disproportionately large. However, for major price increases, such a compensation scheme — or perhaps a series of lump sum payments — may be politically necessary to compensate households for the impact on incomes. On the positive side, this approach allows the price mechanism to work, and does not interfere with the finances of the utility. In Albania, increases in wages, pensions, unemployment benefits, and welfare payments were used to compensate households for 75 % of the increase in power tariffs in 1994. The main issue associated with wage increases would be the possible, and in the transition economies probable, wage-price spirals that may be generated by wage compensation for price increases. "Political economy" aspects make such restitution particularly dangerous in the transition economies. Given the socialist legacy of entitlement, this approach could establish a perceived entitlement to *general* compensation for price increases (as distinct from *targeted* compensation to at risk groups), and may set unwise precedents. Any compensation should therefore take a one-time-only form and be targeted to at-risk groups.

The preferred approaches

Cash payments to at risk groups are probably the preferred compensation scheme. They are targeted, fiscally narrow, allocatively efficient, and, since they are financed by the budget they are not financially harmful to the utilities. Whatever the approach, the choice should be based on the current social assistance system and on future social assistance policies, and should be coordinated with energy sector objectives. A lifeline rate with a single block may be preferable if social assistance targeting is sufficiently weak. And, it could be phased out over time--perhaps by shrinking the block. It must be kept in mind that the need for social assistance in turn is affected by the method of price compensation chosen. If targeting through subsidized energy pricing is introduced, then this should be factored into the level of social assistance. If prices are allowed to rise to market prices for everyone then some form of compensation through social assistance should be implemented to offset these high costs for the poor.

The political economy of price increases

In the end, however, the political economy dimension may dominate: often it is not "the poor" who are government's concern, but the broad middle. In this case, some broad-based income\wage compensation scheme may be the instrument of (political) choice: ideally it would offer (very) partial compensation (i.e. wages would rise by less than the amount of the price rise, weighted by energy's budget share); and perhaps for the first year(s), income tax brackets would not be adjusted, so as to "claw back" some of the gains. Alternatively, the indexation applied could be progressive, compensating higher income groups for a smaller proportion of the price rise than lower income groups.

V. Implications for Pricing Policy

From the analysis of sections III and IV, it appears that if pricing policy going to be used as a means to redistribute income (although we do not advocate price policy as a redistributive tool), electricity is probably the best vehicle compared to other energy sources. Increased electricity prices hurt the poor more than increases of other energy prices. But the non-poor consume much more electricity than do the poor, so that raising prices would be progressive in its impact. And, subsidizing electricity prices -- as distinct from targeted cash payments -- raises the question of interfuel substitution. If families can substitute away from other fuel sources toward electricity this will have serious distortionary effects. One way to mitigate both problems is by offering lifeline pricing for a small quantity of electricity only.

Welfare analysis of lifeline pricing

Lifeline pricing creates a supply curve that is horizontal at a low price for the initial block of subsidized energy, then jumps to the "correct" economic price for all additional consumption (see figure 2). Here we assume that the price is not increased for the block of energy that is subsidized, but for all energy above the block consumers pay the true price. The loss in consumer surplus due to the price change will now be the additional amount consumers pay for energy that is consumed over the first block (area A) plus the loss due to changed consumption resulting from the higher price (area B). It will be the same as before[24], less the value of the first block (area C), for which no welfare is lost. If the consumer uses more than the first block after lifeline pricing is implemented, then the loss, ΔCS (the shaded area in figure 2), will be:

$$\Delta CS = Q_0(p^*-p_B)(1 + \epsilon(p^*-p_B)/2p_B)-Q_B(p^*-p_B)$$

Where Q is quantity, p is price, ϵ is the price elasticity of demand, the subscript 0 refers to the initial period, the subscript B refers to the block of subsidized energy, and the superscript * refers to the efficient price and quantity. So, the change in consumer surplus as a percentage of the budget is:

$$\Delta CS/E = (S_0(p^*-p_B)/p_B)(1 + \epsilon(p^*-p_B)/2p_B)-S_B(p^*-p_B)/P_B$$

Where S_0 is the share of energy at the price p_B and S_B is the share of budget share of the subsidized block of energy also at price p_B.

If the consumer chooses to consume exactly the first block after lifeline pricing is implemented then he will suffer a small welfare loss (figure 3). That is, if the demand curve crosses supply where the supply curve is vertical, then the consumer loses the surplus from the additional electricity he would have consumed had the price remained low. He consumes exactly the first block

24/ Recall that the loss in consumer surplus, as calculated previously, was the area between the demand curve and the vertical axis, and above the old price and below the new price.

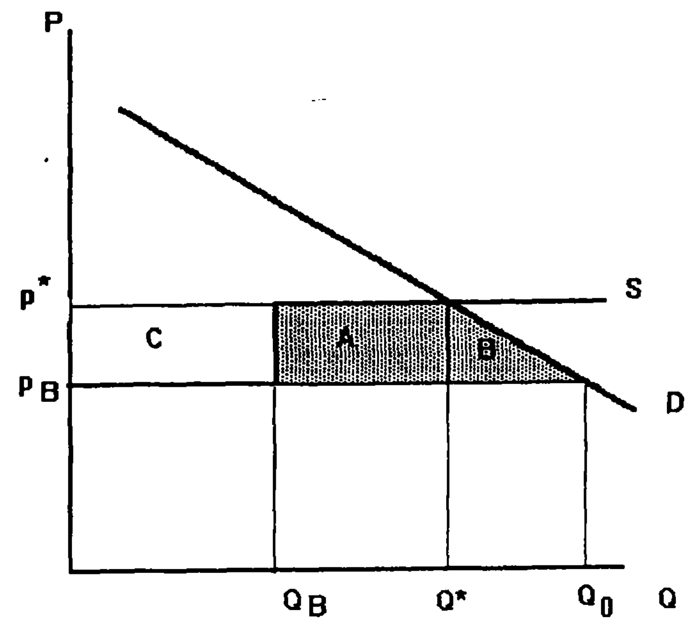

Figure 2

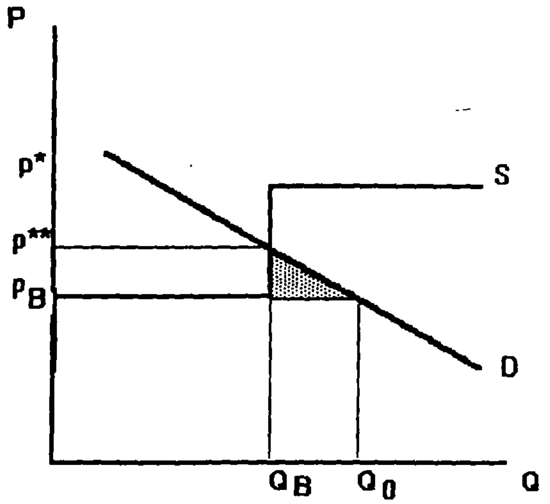

Figure 3

of electricity and loses the shaded triangle in figure 3. In this case the change in consumer surplus will be:

$$\Delta CS = (Q_0 - Q_B)(p^{**} - p_B)/2)$$

$$\Delta CS/E = (Q_0 - Q_B)(p^{**} - p_B)/2E$$

Where p** is the price the consumer would be willing to pay to consume the lifeline block of energy.[25] Clearly, if he consumes below the cutoff QB both before and after lifeline pricing is implemented, his loss will be zero.

To estimate the impact of lifeline pricing on different income groups we examined the case of a single block of electricity and used demand information from the household budget survey with a range of reasonable price elasticities. The June, 1993 price of electricity was Zl 864 kwh. We assumed that the lifeline rate for the first block remains unchanged at ZL 864 kwh, and an 80 percent price increase is implemented for any additional consumption (table 11). We estimated the loss in consumer surplus for a bock of 100 kwh per household and 50 kilowatt hours per household, per month.

Empirical results: lifeline pricing

Although this is only illustrative exercise, it shows that some targeting can be achieved by offering a small block of cheaper electricity to consumers. There still are several problems however. For one thing, lifeline blocks can not be offered on a per-capita basis, which weakens their targeting power. Poor families tend to be larger than the non poor--the average household size of households with income below the poverty line is 4.27 persons, while those above the poverty line have an average size of 3 people. And, lifeline pricing is unlikely to be the most cost effective way of helping the poor consume energy: there is still leakage to the non-poor.

If raising prices to efficient levels for all consumers is not politically feasible at present, the evidence suggests that it may be socially *better to use lifeline pricing and a large price increase than*

25/ Note that, $p^{**} - p_B = P_B(Q_B - Q_0)/Q_0\epsilon$.

an overall, but smaller price increase. Note that lifeline pricing for electricity in combination with an 80% price increase has better distributional effects than an across the board price rise for electricity. While both a 50 percent overall price increase and an 80 percent price increase in combination with a 100 kwh lifeline block result in approximately the same gross revenues to the utility (assuming a zero elasticity and hence no change in consumption), lifeline pricing is easier on the poor than on the non-poor, while increasing prices across the board is actually *harder* on the poor than on the non-poor (this remains true for all the values of elasticity chosen). Figure 4 shows the welfare loss as a function of expenditure category under the alternative pricing regimes: lifeline pricing results in a burden that is roughly *increasing* with income, while an overall price increase is associated with a *decreasing* burden across expenditure groups. Under lifeline pricing the poorest group loses 1.4 percent of their budget while the richest groups lose 1.7 percent. A smaller but across-the-board price increase of 50 percent implies a welfare loss for the poorest quintile of 1.8 percent, and for the richest only 1.4 percent. The distributional effect is reduced, but still quite evident when the block is smaller. A block of 50 kwh in combination with an 80% price increase for additional consumption hits all consumers with approximately the same welfare loss of about 2.1 percent as a percent of their respective budgets assuming a zero elasticity (table 1), while an across the board increase in the price of electricity hits the poor harder (see appendix tables 3-7).

Figure 4 Welfare Loss as a percent of the budget-- 100 kwh lifeline pricing and 80% price increase vs. 50% price increase (price elasticity of demand 0)

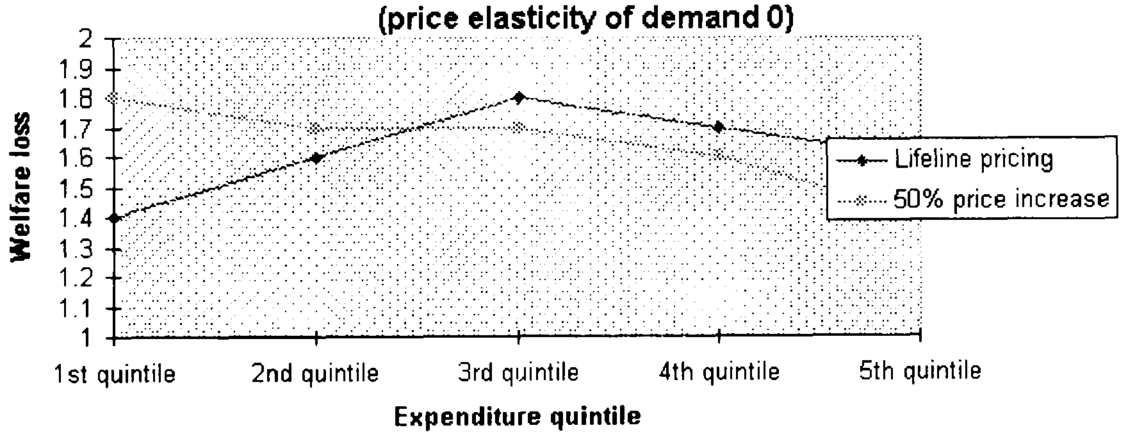

Table 11: Welfare Loss of 100 kwh and 50 kwh monthly lifeline blocs with 80 percent price increase for consumption above the lifeline (as a percentage of total expenditures)

Expenditure group	Amount spent on electricity (1,000 zl)*	Quantity per capita*	Household size	Block per capita (100kwh/hh size) (50kwh/hh size)	Welfare loss (percent of budget)		
					$\varepsilon = 0$	$\varepsilon = -.5$	$\varepsilon = -1$[26]
1 (poorest)	42.13	48.77	4.03	24.81 12.41	**1.4** **2.1**	0.8 1.6	0.4 1.0
2	59.22	68.54	3.41	29.32 14.66	1.6 2.2	1.0 1.6	0.6 1.1
3	75.40	87.27	3.04	32.89 16.45	1.8 2.3	1.2 1.7	0.7 1.2
4	88.65	102.61	2.72	36.76 18.38	1.7 2.1	1.1 1.5	0.7 1.0
5 (richest)	117.67	136.20	2.47	40.48 20.24	**1.6** 1.9	1.1 1.4	0.6 1.0
all	76.62	88.68	3.13	31.94 15.97	1.7 2.2	1.2 1.7	0.6 1.2

* From household budget survey. Source: Authors' simulations. Assumes 80% price increase for non-lifeline bloc.

Some advantages and disadvantages of lifeline rates

There are a few other caveats on lifeline pricing. It is important that the lifeline block remains small. Lifeline subsidies may not be the best way to subsidize energy if the value of the subsidy to consumers is less than the cost of providing the subsidy. The value of the

26/ Note that in some cases the consumption will be reduced to exactly the block. For these cases the method corresponding to figure 3 was used to calculate the welfare loss.

subsidy to the consumer is the amount of money that the consumer would be willing to pay for the subsidy. For consumers using less than the subsidized block the value of electricity at the margin is its subsidized price and the value of the subsidy is therefore zero. For these consumers waste arises since the cost of the subsidy exceeds their value of it. There is no waste for consumers who use more than the first block, since they value the subsidized energy above its cost. Larger lifeline price reductions result in more waste as a percentage of the total subsidy (since more consumers fall inside the subsidized block) and smaller blocks create less waste (Scott 1981)[27]. Additionally, a large lifeline block, though it may be an appealing way of meeting the needs of the poor and the middle class, could be costly to implement. Take our example above, a 50 kwh monthly lifeline block would cost the utilities about Zl 34,560 per household per month in foregone revenue (as compared to an 80% price increase of all consumption and assuming a zero elasticity), and a 100 kwh block would cost twice that amount. A block designed to meet the needs of the median consumer (about 250 kwh) would cost the power company about Zl 170,000 (just under $10 at 1993 exchange rates) per household per month.

If the purpose of lifeline pricing is to redistribute income, to effectively achieve this objective, subsidies must be significant. As the amount of assistance by way of pricing policy increases, however, so too does the loss in terms of waste. Scott 1981, finds that this tradeoff between equitability and efficiency does not favor lifeline pricing as a way to help the poor. "Subsidized rates for electricity. . . do not seem to be the most efficient means of raising real income of the poor, the elderly , or the disabled. . . *Only an extensive lifeline program can have even a noticeable effect* on the living standards of recipients. The waste to recipients of such a program, however, would be substantial." (Scott pp. 543). Nonetheless, in an environment where other approaches are difficult due to inability to target, or administratively weak social welfare systems, as in the transition economies, lifeline pricing may remain the best option.

27/ To estimate the value of various types of subsidies to those who consume less than the full block, the shape of the demand curve must be known. Scott assumes that consumers have cobb-douglass utility -- i.e. price elasticity and income elasticity of demand for electricity are equal to one in absolute value.

Conclusions

This paper looks at the welfare effects of increasing energy prices. Our main finding--- not too surprising -- is that the policy of subsidizing energy prices, common in the transition economies of eastern Europe and the former Soviet Union, is *regressive*. While such programs do help the poor in providing them with lower cost energy, they are more useful to the rich who consume more energy. What *is* surprising is the extent to which the non-poor have benefited from lower energy prices; not only do the wealthy consume more energy than the poor, they spend a larger portion of their income on energy as well.

Based on this analysis, we are able to rule out the oft-used social welfare argument for delaying energy price increases, though we make no attempt to answer the broader question of what the dynamically efficient pricing path should be. Better targeting than is attained through energy subsidies can be achieved directly through a social assistance program. If some relief is desired for *all* consumers during the transition, while incomes are low, *lifeline pricing for a small block of electricity, accompanied by significant price increases, is feasible, and simulations show this approach may be more equitable than raising prices across the board, but more slowly, for all consumers.* Ideally the public utility would be compensated for reduced price sales from the budget, rather than having to finance it by internal cross-subsidies.

Associated with the energy sector in the transition economies today are a host of inefficiencies: allocative, productive, dynamic, and financial. Here we have tackled the allocative effectiveness of pricing policy and found that subsidizing household energy consumption does not help to redistribute income efficiently. Moreover, price controls lead to significant inefficiencies on the production side that are likely to have a heavy cost over time. What is still needed--and remains under much debate is a more general framework to evaluate the tradeoffs and costs to society of taking a big bang approach or taking a gradual approach to adjustment of the energy sector prices.

Appendix

Table 1: Electricity Pricing in 1994

US cents/kWh

(percent of conventionally estimated LRMC cost in parenthesis)

Country	Industrial	Residential	Ratio Residential Industrial
Hungary	5.2 (130%)	5.5 (70-80%)	1.0
Poland	3.7 (60-70%)	5.1 (50-60%)	1.4
Albania	4-4.5 (90-100%)	5.4 (70-80%)	1.25
Czech Republic	5.6 (95-110%)	2.7 (30-40%)	0.5
Slovakia	4.6-5.5 (100-110%)	2.7 (40%)	0.6
Bulgaria	2.4 (60-70%)	0.75 (10-15%)	0.3
Russia	2.7 (75-90%)	0.6 (10-15%)	0.22
Ukraine	1.4 (40-60%)	0.34 (4-10%)	0.25
OECD Average	7.4	14.0	1.9
Turkey	10.0	10.1	1.0

Table 2: Natural Gas Pricing 1994

US cents/cubic meter

(percent of estimated economic cost in parenthesis)

Country	Industrial	Residential	Ratio Residential
Hungary	28 (112%)	24 (80%)	0.86
Poland	12 (90-110%)	17 (60-70%)	1.4
Slovakia	12 (90-110%)	10-15 (50-65%)	0.8-1.2

Source: World Bank and IEA

Table 3: Welfare loss from a 20% price increase

Category	Heat			Electricity			Gas			Energy		
Elasticity	0	-.5	-1	0	-.5	-1	0	-.5	-1	0	-.5	-1
1 (poorest)	0.3	0.3	0.2	0.7	0.7	0.6	0.3	0.3	0.2	1.5	1.4	1.3
2	0.3	0.3	0.3	0.7	0.7	0.6	0.3	0.3	0.3	1.8	1.7	1.6
3	0.4	0.4	0.4	0.7	0.7	0.6	0.4	0.4	0.4	2.0	1.9	1.8
4	0.4	0.4	0.4	0.6	0.6	0.6	0.4	0.4	0.4	2.2	2.0	1.9
5 (richest)	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.4	0.4	2.1	1.9	1.8
All	0.4	0.4	0.4	0.7	0.6	0.6	0.4	0.4	0.3	1.9	1.8	1.7

Table 4: Welfare loss from a 40% price increase

Category	Heat			Electricity			Gas			Energy		
Elasticity	0	-.5	-1	0	-.5	-1	0	-.5	-1	0	-.5	-1
1 (poorest)	0.6	0.5	0.5	1.4	1.3	1.1	0.5	0.5	0.4	2.9	2.7	2.4
2	0.9	0.8	0.7	1.4	1.2	1.1	0.7	0.6	0.5	3.6	3.2	2.9
3	1.0	0.9	0.8	1.4	1.2	1.1	0.8	0.7	0.6	4.1	3.7	3.2
4	1.0	0.9	0.8	1.3	1.1	1.0	0.9	0.8	0.7	4.3	3.9	3.5
5 (richest)	0.9	0.8	0.7	1.1	1.0	0.9	0.9	0.8	0.7	4.1	3.7	3.3
All	0.9	0.8	0.7	1.3	1.2	1.1	0.8	0.7	0.6	3.8	3.4	3.0

Table 5: Welfare loss from a 60% price increase

Category	Heat			Electricity			Gas			Energy		
Elasticity	0	-.5	-1	0	-.5	-1	0	-.5	-1	0	-.5	-1
1 (poorest)	0.9	0.8	0.6	2.1	1.8	1.5	0.8	0.7	0.6	4.4	3.8	3.1
2	1.3	1.1	0.9	2.1	1.8	1.4	1.0	0.9	0.7	5.4	4.6	3.8
3	1.5	1.3	1.1	2.1	1.8	1.5	1.2	1.0	0.8	6.1	5.2	4.3
4	1.5	1.3	1.1	1.9	1.6	1.3	1.3	1.1	0.9	6.5	5.5	4.5
5 (richest)	1.3	1.1	0.9	1.6	1.4	1.1	0.1	1.1	0.9	6.2	5.2	4.3
All	1.3	1.1	0.9	2.0	1.7	1.4	1.1	1.0	0.8	5.7	4.9	4.0

Table 6: Welfare loss from a 100% price increase

Category	Heat			Electricity			Gas			Energy		
Elasticity	0	-.5	-1	0	-.5	-1	0	-.5	-1	0	-.5	-1
1 (poorest)	1.5	1.1	0.7	3.6	2.7	1.8	1.3	1.0	0.7	7.4	5.5	3.7
2	2.2	1.6	1.1	3.4	2.6	1.7	1.7	1.3	0.8	9.0	6.7	4.5
3	2.6	1.9	1.3	3.5	2.6	1.7	2.0	1.5	1.0	10.2	7.6	5.1
4	2.6	1.9	1.3	3.2	2.4	1.6	2.2	1.6	1.1	10.8	8.1	5.4
5 (richest)	2.2	1.7	1.1	2.7	2.0	1.4	2.2	1.7	1.1	10.3	7.7	5.1
All	2.2	1.7	1.1	3.3	2.5	1.7	1.9	1.4	1.0	9.5	7.1	4.8

Table 7: Welfare loss from a 120% price increase

Category	Heat			Electricity			Gas			Energy		
Elasticity	0	-.5	-1	0	-.5	-1	0	-.5	-1	0	-.5	-1
1 (poorest)	1.8	1.3	0.7	4.3	3.0	1.7	1.6	1.1	0.6	8.8	6.2	3.5
2	2.6	1.8	1.0	4.1	2.9	1.7	2.0	1.4	0.8	10.8	7.5	4.3
3	3.1	2.2	1.2	4.2	2.9	1.7	2.4	1.6	1.0	12.2	8.6	4.9
4	3.1	2.2	1.2	3.8	2.7	1.5	2.6	1.8	1.0	12.9	9.1	5.2
5 (richest)	2.6	1.9	1.1	3.3	2.3	1.3	2.7	1.9	1.1	12.3	8.6	4.9
All	2.6	1.8	1.1	4.0	2.8	1.6	2.3	1.6	0.9	11.4	8.0	4.6

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